

CLAIMS

1. A data processing apparatus operable to identify at least one of a plurality of code words, forming a code word set, present in a marked version of a material item, the marked version having been formed by combining each of a plurality of parts of a code word with one of a plurality of units from which the material item is comprised, the apparatus comprising

a recovery processor operable to recover at least one part of the code word from a corresponding unit of the marked material item, and

10 a correlator operable to generate for the marked material unit a dependent correlation value for the part of the code word recovered from the material unit and the corresponding part of at least one of the re-generated code words from the set, and

a detector operable to determine whether at least one of the code words is present in the marked material item from the dependent correlation value for the part of the code word exceeding a predetermined threshold.

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2. A data processing apparatus as claimed in Claim 1, wherein the detector is operable in combination with the correlator to form a dependent correlation value for a plurality of parts of the recovered code word, and if the correlation value exceeds the predetermined threshold for one of the dependent correlation values, the detector is 20 operable to identify the code word as present according to a predetermined false detection probability.

25 3. A data processing apparatus as claimed in Claim 2, wherein the detector is operable in combination with the correlator to form the dependent correlation values by combining the parts of the code word recovered from successive material units, and by correlating the parts formed from successive material units with corresponding part of the regenerated code word.

30 4. A data processing apparatus as claimed in Claim 3, wherein the correlator is operable to form the dependent correlation values by combining the parts of the code word recovered from a first plurality of successive units with parts of the

code word recovered from second plurality of successive units and correlating the combined parts with corresponding parts of the re-generated code word.

5. A data processing apparatus as claimed in Claim 1, wherein the correlator is operable under control of the detector

to combine the parts of the code word recovered from a first plurality of successive units, and to form the dependent correlation value for the combined parts, the detector being operable to detect the code word if the dependent correlation value exceeds the predetermined threshold and otherwise

10 to combine the parts of the code word recovered from a second plurality of successive units, the number of units corresponding to the first plurality, and to form the dependent correlation value for the combined parts, the detector being operable to detect the code word if the dependent correlation value exceeds the predetermined threshold and otherwise

15 to combine the parts of the code word recovered from the first plurality of successive units with parts of the code word recovered from the second plurality of successive units, and to form the dependent correlation value for the combined parts, the detector being operable to detect the code word if the dependent correlation value exceeds the predetermined threshold and otherwise

20 to combine the parts of the code word recovered from a third plurality of successive units, and to form the dependent correlation value for the combined parts, the detector being operable to detect the code word if the dependent correlation value exceeds the predetermined threshold and otherwise

25 to combine the parts of the code word recovered from a fourth plurality of successive units, the number of units corresponding to the third plurality, and to form the dependent correlation value for the combined parts, the detector being operable to detect the code word if the dependent correlation value exceeds the predetermined threshold and otherwise

30 to combine the parts of the code word recovered from the third plurality of successive units with parts of the code word recovered from the fourth plurality of successive units, and to form the dependent correlation value for the combined parts, the detector being operable to detect the code word if the dependent correlation value

exceeds the predetermined threshold and otherwise to form iteratively the first, second, third and fourth plurality of parts of the recovered code word, and to determine whether the dependent correlation value exceeds the threshold.

5        6. A data processing apparatus as claimed in Claim 5, wherein the correlator is operable under control of the detector to form an iteratively increasing length part of the code word formed from successive material units and to determine the dependent correlation value for the increased length part of the code word, the iteration increasing until the whole code word is recovered and correlated with the  
10 regenerated code word, the correlation value produced being an independent correlation value.

15        7. A data processing apparatus as claimed in Claim 1, wherein the detector and the correlator are operable in combination to form the dependent correlation value for at least one selected code word re-generated from the set of code words, the code word being selected from the set in accordance with the relative magnitudes of the dependent correlation value formed for each code word of the set.

20        8. A data processing apparatus as claimed in Claim 1, wherein the plurality of code words are formed from a first code word having a plurality of predetermined pseudo-randomly distributed coefficients and by generating other code words of the set by cyclically shifting the first code word, and the correlation value is formed for a plurality of the code words by

25              forming a Fourier transform of the recovered code word,  
            forming a Fourier transform of the first code word of the set,  
            forming the complex conjugate of one of the Fourier transform of the recovered code word and the Fourier transform of the regenerated code word,  
            forming intermediate product samples by multiplying each of the Fourier transform samples of the recovered code word and the corresponding Fourier transform samples of the first code word,  
            forming correlation samples by forming an inverse transform of the intermediate product samples, each of the correlation value samples providing the

correlation value for one of the set of code words, wherein the forming a Fourier transform of the part of the recovered code word comprises setting the remaining part of the recovered code word to zero, and forming the Fourier transform of the recovered code word, and

5       the forming a Fourier transform of the first code word of the set comprises setting the remaining part of the first code word to zero, and forming the Fourier transform of the first code word.

9.       A data processing apparatus as claimed in Claim 1, wherein the code  
10 word has been introduced into the material item in the discrete cosine transform domain, the apparatus comprising

a discrete cosine transform processor operable to transform the marked material item and the original material item into the discrete cosine transform domain, wherein the recovery processor is operable to generate the recovered code word by  
15 subtracting corresponding discrete cosine transform coefficients of the original material version from discrete cosine transform coefficients of the marked material version.

10.      A data processing apparatus as claimed in Claim 1, wherein the material is video material, the material units being video images.

11.      A method of identifying one of a plurality of code words present in a marked material item, the marked version having been formed by combining each of a plurality of parts of a code word with one of a plurality of units from which the material item is comprised, the method comprising

recovering at least one part of the code word from a corresponding plurality of units of the marked material item, and

generating for the marked material unit a dependent correlation value for the part of the code word recovered from the material unit and the corresponding part of at  
30 least one of the re-generated code words from the set, and

determining whether at least one of the code words is present in the marked material item from the dependent correlation value for the part of the code word exceeding a predetermined threshold.

5        12. A method of identifying as claimed in Claim 11, wherein the generating a dependent correlation value comprises

forming a dependent correlation value for each of a plurality of parts of the recovered code word, and if the correlation value exceeds the predetermined threshold for one of the dependent correlation values,

10      identifying the code word as present according to a predetermined false detection probability.

13. A method of identifying as claimed in Claim 12, wherein the generating a dependent correlation value includes forming the dependent correlation values by combining the parts of the code word recovered from successive material units, and by correlating the parts formed from successive units with corresponding part of the regenerated code word.

14. A method of identifying as claimed in Claim 13, wherein the generating a dependent correlation value includes forming the dependent correlation values by combining the parts of the code word recovered from a first plurality of successive units with parts of the code word recovered from second plurality of successive units and correlating the combined parts with corresponding parts of the re-generated code word.

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15. A method of identifying as claimed in Claim 11, wherein the generating a dependent correlation value includes

combining the parts of the code word recovered from a first plurality of successive units,

30      forming the dependent correlation value for the combined parts, and detecting the code word if the dependent correlation value exceeds the predetermined threshold and otherwise

combining the parts of the code word recovered from a second plurality of successive units, the number of units corresponding to the first plurality,

forming the dependent correlation value for the combined parts, and detecting the code word if the dependent correlation value exceeds the predetermined threshold  
5 and otherwise

combining the parts of the code word recovered from the first plurality of successive units with parts of the code word recovered from the second plurality of successive units,

10 forming the dependent correlation value for the combined parts, and detecting the code word if the dependent correlation value exceeds the predetermined threshold and otherwise

combining the parts of the code word recovered from a third plurality of successive units,

15 forming the dependent correlation value for the combined parts, and detecting the code word if the dependent correlation value exceeds the predetermined threshold and otherwise

combining the parts of the code word recovered from a fourth plurality of successive units, the number of units corresponding to the third plurality,

20 forming the dependent correlation value for the combined parts, and detecting the code word if the dependent correlation value exceeds the predetermined threshold and otherwise

combining the parts of the code word recovered from the third plurality of successive units with parts of the code word recovered from the fourth plurality of successive units,

25 forming the dependent correlation value for the combined parts, and detecting the code word if the dependent correlation value exceeds the predetermined threshold and otherwise

forming iteratively the first, second, third and fourth plurality of parts of the recovered code word, and

30 determining whether the dependent correlation value exceeds the threshold.

16. A method of identifying as claimed in Claim 15, wherein the generating a dependent correlation value includes

forming iteratively a part of the code word of increasing length, from successive material units, and

5 determining the dependent correlation value for the increased length part of the code word, the iteration increasing until the whole code word is recovered and correlated with regenerated code word, the correlation value produced being a independent correlation value.

10 17. An encoding data processing apparatus operable to form a marked version of a material item by combining each version of a material item with one or more of a plurality of code words from a code word set, each of a plurality of parts of the code word being combined with one of a plurality of units from which the material item is comprised.

15 18. An encoding data processing apparatus as claimed in Claim 17, wherein the plurality of code words are formed from a first code word having a plurality of predetermined pseudo-randomly distributed coefficients and by generating other code words of the set by cyclically shifting the first code word.

20 19. An encoding data processing apparatus as claimed in Claim 17, wherein successive parts of the code word are combined respectively with successive units of the material item.

25 20. A method of forming marked versions of a material item, comprising combining each version of a material item with one of a plurality of code words from a code word set, wherein the combining comprises combining each of a plurality of parts of the code word with one of a plurality of units from which the material item is comprised.

30 21. A system for identifying versions of a material item, the system comprising

an encoding data processing apparatus operable to form marked versions of the material item by combining each version with at least one of a plurality of code words from a code word set, each of a plurality of parts of the code word being combined with one of a plurality of units from which the version of the material item is comprised, and

a detecting data processing apparatus operable to identify at least one of the plurality of code words present in a marked version of the material item, the detecting data processing apparatus comprising

10 a recovery processor operable to recover at least one part of a code word from a corresponding unit of the marked material item, and

a correlator operable to generate for the marked material unit a dependent correlation value for the part of the code word recovered from the material unit and the corresponding part of a code word re-generated from the code word set, and

15 a detector operable to determine whether at least one of the code words is present in the marked material item from the dependent correlation value for the part of a code word exceeding a predetermined threshold.

22. A computer program providing computer executable instructions, which when loaded on to a data processor causes the data processor to perform the  
20 method according to Claim 11.

23. A computer program providing computer executable instructions, which when loaded on to a data processor causes the data processor to perform the method according to Claim 20.

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24. A medium carrying a computer program as claimed in Claim 22.

25. A medium carrying a computer program as claimed in Claim 23.